MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

TAI2151 – ARTIFICIAL INTELLIGENCE FUNDAMENTALS

(All Sections/Groups)

28 MAY 2019
9.00am – 11.00am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **5** pages with **5** questions only.
2. Attempt **ALL FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

Question 1

Imagine a futuristic world where numerous types of robots are used. One is an armoured transport vehicle whose job is to take a person to a location of that person's choice. The transport only drives to approved locations and only on special roads dedicated to transport robots. The speed limit is the same for all roads. Traffic is not an issue as all roads are single lane in each direction and all traffic moves at the same speed. There are no issues related to sensing. The robot software is implemented using a goal-based architecture. The following is the PEAS description:

Performance: Get person to location, take shortest route
Environment: Client, enemies, other vehicles, roads
Actuators: Steering, accelerator, brake, speaker
Sensors: Camera, sonar, speedometer, GPS, voice input

(a) Describe the environment with some justifications:
Is it fully or partially observable? (1 mark)
Is it deterministic or stochastic? (1 mark)
Is it static or dynamic? (1 mark)
Is it discrete or continuous? (1 mark)
Is it single or multi-agent? If multi-agent, who are the other agents and are the agent interactions competitive or cooperative? (2 marks)

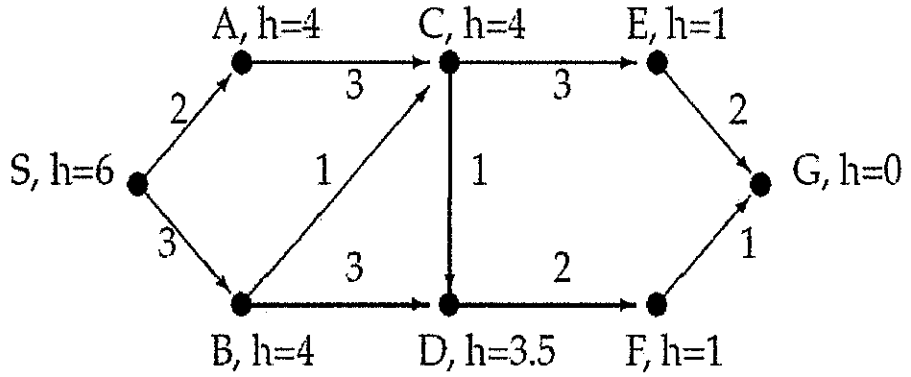
(b) What in this problem makes a goal-based architecture a good choice? (2 marks)
Why aren't the simple or model-based reflex architectures a good choice? (2 marks)

Continued....

Question 2

(a) A* search generates an optimal solution provided it is given an admissible heuristic. Describe what is an admissible heuristic, and how will it affect the optimality of A* search. (3 marks)

(b) The graph below represents a problem space. Nodes are labelled with a letter and a heuristic function ***h*** value. Edges are labelled with traversing cost. Suppose we want to use the Greedy Search algorithm on the graph to find the path from node ***S*** to node ***G***.



(i) Filling the table below. The table is a simulate running of Greedy Search algorithm on the graph, showing the ***h*** value of each node on the queue. If you find a new path to a node already on the queue, update its cost (using the lower ***h*** value) instead of adding another copy of that node to the queue. Keep the queue sorted. When two or more nodes are generated at the same time, the selection is based on the alphabetical order of their labels. (5 marks)

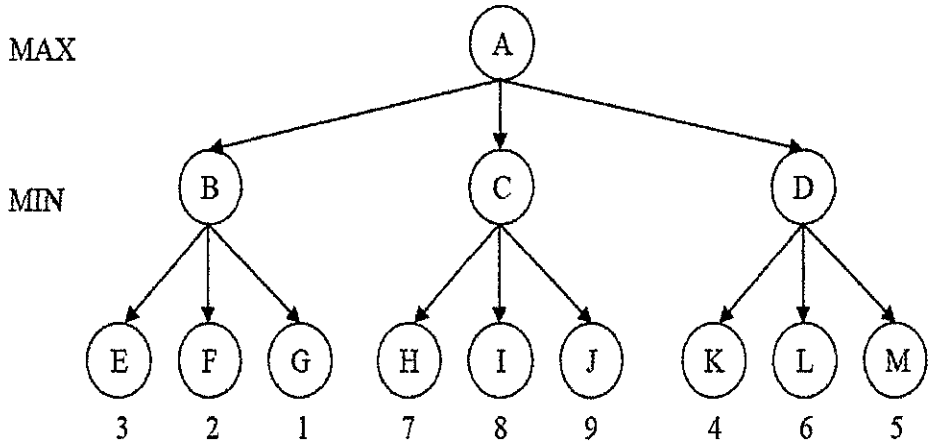
Iteration	Node Visited / Expanded	Priority Queue (aka Fringe, Open List) Notation for a Node is NAME(H value)
0	--	S(6)
1	S	A(4), B(4)
2		
3		
4		
5		
6		

(ii) For the solution found in (b)(i), give the cost and sequence of nodes comprising the path. (2 marks)

Continued....

Question 3

Consider this game tree where the root is a maximizing node, and children are visited from left to right.



(a) Compute the minimax game value of nodes A, B, C, and D using the standard minimax algorithm. (2 marks)

(b) What move will be selected by player one using minimax? (1 mark)

(c) List the nodes (leaves or interior nodes) that alpha-beta algorithm prunes (i.e., decides need not be examined). (2 marks)

(d) The number of nodes that alpha-beta algorithm prunes depends on how each node's children are ordered in the tree.

(i) How to obtain a new game tree by re-ordering the children of each internal node, such that the new game tree is equivalent to the tree above, but alpha-beta pruning will prune as many nodes as possible?

(ii) List the nodes that would be pruned.

(5 marks)

Continued....

Question 4

You are given the following predicates:

dog(X) = X is a dog
animal(X) = X is an animal
dies(X) = X dies

(a) Translate the following English sentences into First-Order Logic statements:
1. Fido is a dog.
2. All dogs are animals.
3. All animals will die. (2 marks)

(b) Convert the First-Order Logic statements obtained in (a) into Conjunctive Normal Form. (2 marks)

(c) Use resolution refutation to prove that Fido will die. (6 marks)

Continued....

Question 5

A candy manufacturer interviews a customer on his willingness to eat a candy of a particular colour or flavour. The following table shows the collected responses:

Colour	Flavour	Edibility
Red	Grape	Yes
Red	Cherry	Yes
Green	Grape	Yes
Green	Cherry	No
Blue	Grape	No
Blue	Cherry	No

For your information, $log_2\ 1 = 0$, $log_2\ 2 = 1$, $log_2\ 3 = 1.6$, $log_2\ 4 = 2$, $log_2\ 5 = 2.3$
Also, $log(x/y) = log\ x - log\ y$

(a) What is the information content of the feature edibility, *I(Edibility)*? Show your work. (2 marks)

(b) What is the information content of the feature edibility knowing a particular colour, *I(Edibility | Colour)*? Show your work. (2 marks)

(c) Which feature (colour or flavour) has the larger mutual information with edibility? (2 marks)

(d) Draw the decision tree for predicting edibility that maximizes the information gain. (2 marks)

(e) Using your decision tree, what would you predict for the edibility of a blue coloured, and cherry flavoured candy? (2 marks)

End of Paper